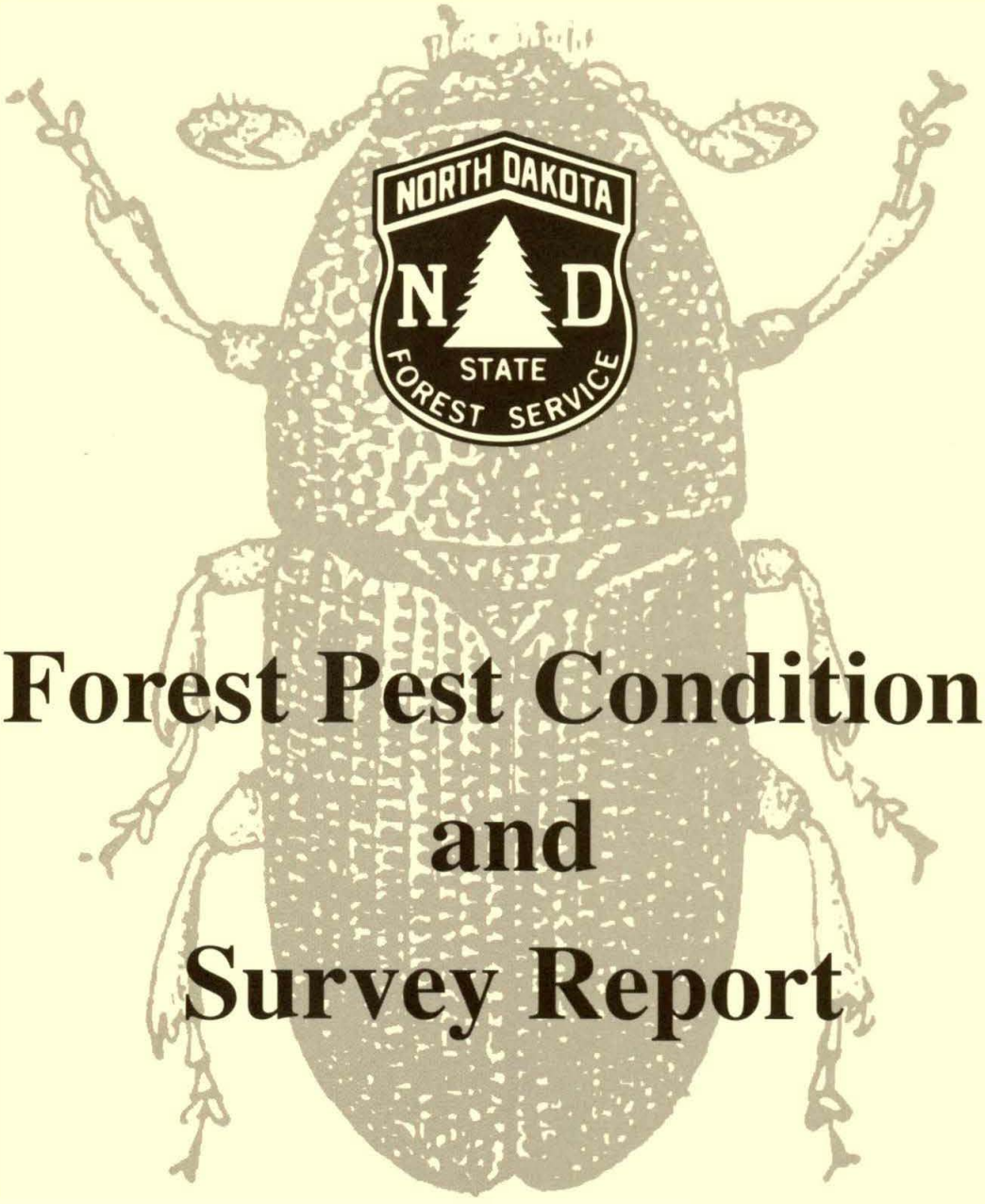
NORTH DAKOTA



Forest Pest Conditions and Survey Report

1990-91

See Page 28
Diagnosing Tree Problems
Using Injury Symptoms

NORTH DAKOTA FOREST SERVICE

State Forester First & Brander Bottineau, ND 58318 (701) 228-2277 (ext. 290)

MEMORANDUM

TO: Forestry Related Agencies and Organizations

FROM: Larry A. Kotchman, State Forester

SUBJECT: June 1, 1992

DATE: 1990-91 ND Forest Pest Conditions and Survey Report

Enclosed is a copy of the 1990-91 Forest Pest Conditions and Survey Report of the native and planted trees and shrubs of North Dakota.

With the aid of USDA-Forest Service funding, this report and assistance on pest identification, evaluation and control was provided by Arden Tagestad.

Included in the report is a special section on "Diagnosing Tree Problems by Using Injury Symptoms." This is rapidly becoming a very sought after guide. Condensed laminated copies (8 1/2" x 11") are available for field use. If you would like a copy, please let us know.

As we enter into another growing season, we hope our survey findings will help alert you to potential pest problems in your area.

Enclosure

DIAGNOSING TREE PROBLEMS USING INJURY SYMPTOMS

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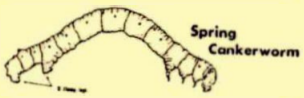
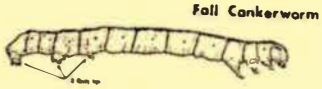


INTRODUCTION



By comparing injury symptoms to examples listed in this guide, it is possible to identify over 140 specific insect, disease or abiotic tree and shrub problems. For the novice, this provides a "name" that can be used for further investigation by referring to a suitable text or in calls to pest specialists. For those more familiar with tree problems, this guide may serve as a check list or a reminder of less often encountered problems.

HOW TO USE THIS GUIDE

This guide is broken down by injury to conifers or deciduous trees and shrubs. Within each there are four major categories: **I. INJURY TO FOLIAGE, II. INJURY TO TWIGS OR NEW SHOOTS, III. INJURY TO TRUNKS OR LARGER BRANCHES and IV. ENTIRE TREE DYING.**

To identify a problem, determine the specific nature of the injuries and compare them with examples in the chart.

EXAMPLE: You notice that leaves are being eaten on your elm trees, and while examining the problem you disturb the foliage and caterpillars fall down and hang suspended on a silken thread.

TO IDENTIFY, GO TO:

I. INJURY TO FOLIAGE
A. Leaves being eaten
4. No webbing, but larvae hang from a thread when the foliage is disturbed (cankerworms and associates).

IDENTIFICATION: elms: spring cankerworms.

Although a large percentage of the commonly encountered problems are included, keep in mind there are many that could not be included and new ones continue to appear every year.

Please feel free to contact me if you have questions. And please remember, the first step in control or problem evaluation is proper identification.

CONIFERS

I. INJURY TO NEEDLES

A. Needles being eaten

1. Webbing present, (bud cap often retained by silk)
spruce: spruce budworm
2. No webbing
pine: introduced pine sawfly, European pine sawfly
spruce: yellow headed spruce sawfly, tussock moth
larch: larch sawfly

B. Needles damaged or missing, but not consumed, may be off color or have discolored spots or bands or be mined out

1. Spruce needles fade to purplish or brownish and fall off; Rhizosphaera needlecast, (current years needles undamaged)
2. Pine needles fading to yellowish and developing brownish spots or bands, (second year or older needles); Nemacyclus (Cyclaneusma) needlecast
3. ~~Needles with~~ small waxy white spots
pines and spruce: pine needle scale
4. Needles being mined out in the needle sheaths
pines: tip moths, pine needle sheath miner
5. Needles mined out, usually a tiny hole visable
spruce: spruce needle miner
larch: larch casebearer
6. Needles off color due to microscopic stippled areas, microscopic webbing may be present, individual mites very tiny, not usually visable to the naked eye except on a white background
spruce, junipers, arborvitae: spider mites,
7. Needles with brown spots or dead ends
Pines: ~~Lophodermium~~ needlecast, winterburn, herbicide damage

II. INJURY TO TWIGS OR NEW SHOOTS

A. Shoots dying, deformed or stunted

1. New shoots stunted or dying
pines: Diplodia tip blight
Scotch & mugho pine: dieback symptom (cenangium) spruce: white pine weevil
junipers: Kabitina tip blight
2. Buds and new shoots dying, being mined out
pines: pine tip moth
3. Buds being mined out, small pitch mass present
ponderosa pine: metallic pine pitch nodule maker
4. Large aphids on twigs, branches or main stem
pines and spruce: giant conifer aphid
5. Single gall consisting of large numbers of chambers, near the base of new shoots
spruce: eastern spruce gall adelgid
6. Individual galls grouped together on stems
spruce: spruce gall midge

III. INJURY TO TRUNKS OR LARGER BRANCHES

A. Injury to branches

1. Entire branches dying, lower branches first
spruce: Cytospora canker
2. Woody galls on branches of pines, surface ruptures in the spring revealing an orange spore mass ponderosa and scotch pine: western gall rust
Irregular sized woody galls on junipers or cedars, may swell to large gelatinous mass in wet weather
junipers and cedars: cedar apple rust
Large pitch masses in branch whorls or on the trunks of pines, may cause branch failure or stem breakage, pitch masses turn yellowish with age
pines: Zimmerman pine moth complex
3. Medium sized, singularly shaped pitch masses, or pitch tubes, on the lower bole of tree
pines: red turpentine beetle
4. Regular sized, evenly spaced rows of holes in the bark of the main trunk or large branches
all species: sapsuckers (a woodpecker)
5. Small regularly shaped tunnels under the bark, usually scoring both bark and wood, or a "shothole" pattern in the bark (bark beetles)
pines: pine engravers,(ips sp), spruces: spruce bark beetle
6. Witches brooms, clusters of shoots all orginating near the same point
junipers: cedar apple rusts
pines: Western gall rusts

IV. ENTIRE TREE DYING

A. Dying with needles on

pines: Ips bark beetles, red turpentine beetle
all species: chemical damage, herbicides or soil sterilents, girdling by small rodents, beavers, or porcupines, also by mechanical damage from, lawn mowers, string trimmers, weed barriers, ice, circling roots etc.
all species: drought damage, winter injury

(over for Hardwoods)

DIAGNOSING TREE PROBLEMS BY USING INJURY SYMPTOMS

HARDWOOD TREES & SHRUBS

I. INJURY TO FOLIAGE

A. Leaves being eaten

1. **Webbing present, Larvae forage from silken nests**
   chokecherry: ugly nest tent caterpillar
   Prunus, apples prairie tent caterpillar
   many species: fall webworm
2. **Webbing present, no organized nest, but larvae rest on a silken mat placed on the trunk**
   Many species: forest tent caterpillar
3. **No webbing, but larvae hang from a thread when the foliage is disturbed (cankerworms and associates)**
   elms: spring cankerworms,
   green ash, boxelder, but oak: fall cankerworm, many hardwood species: cankerworms, linden looper, elm spanworm and the half wing geometer may be found in any combination on a particular host
4. **No webbing, free feeding caterpillars**
   Many species of trees and shrubs: there are dozens of species that may be present, usually in low numbers that pose no problems for the host
5. **No webbing, free feeding, but not caterpillars**
   caragana: blister beetles, grasshoppers
   cottonwood, poplars: cottonwood leaf beetle
6. **Leaves folded or tied, with a larvae inside**
   green ash: fruit tree leaf roller
   oak: oak leaf roller,
   aspen: early aspen leaf roller, large aspen tortrix

B. Leaves not eaten, but missing or falling and have discolored spots or dead areas on them

poplars and Caragana: Septoria leaf spot disease
green ash: ash anthracnose

C. Leaves present but damaged

1. **Upper surface of leaf consumed**
   cotoneaster, prunus: pear slugs
   elms: elm leaf beetle
2. **Curled leaves with a woolly mass of aphids inside**
   American elm: wooly elm aphid, woolly apple aphid
3. **Aphids or aphid/like insects on underside of leaf**
   many species: aphids, especially on new growth
   American elm: European elm scale (June/July only)
4. **Yellowish stippled areas on upper surface, black deposits underneath, small black and yellow bug green ash: ash plant bug**
5. **Leaves bronzed or faded with black deposits on underside, insects very delicate in appearance**
   elms, oak, Juneberry, cotoneaster, hawthorns; lace bugs, spider mites
6. **Bladder-like or warty growths on either surface of the leaf, (insect or mite galls)**
   America elm: elm leaf gall
   hackberry: hackberry nipplegall
   boxelder: warty leafgall
   honeylocust: honeylocust pod gall midge
   many species: insect or mite galls
7. **Oak leaves with dense woolly pile-like growths, colors vary from white to reddish or yellowish**
   but oak: woolly oak gall wasp
8. **Dense feltlike patches on the surface or depressions filled with feltlike hairs, (erineum), color can vary from green to brick red**
   boxelder, maples: erineum galls
9. **Distorted new growth, smaller than normal cupped leaves with wavy margins, abnormal color**
   boxelder, Siberian elm: phenoxy herbicides
   many species: herbicide damage
10. **Leaves mined between surfaces**
    populus: leafmining sawfly
    elms, elm leafminer
    birch: birch leafminer
11. **Leaves with necrotic areas, sometimes joining to damage entire leaf**
    green ash: ash anthracnose
    oak: oak anthracnose
12. **Leaf spots, may be lighter colored in the center,**
    populus: Scotona and Marssonia
    caragana: Septoria
    maples: Phyllosticta leaf spot
    prunus: fungal and bacterial leaf spots
    green ash: anthracnose
    apples: frogeye leafspot (black rot), apple scab, cedar apple rust
13. **Leaf spots, black spots resembling tar,**
    maples and willows: tar spot fungus
14. **Leaves with yellowish or whitish dusty deposits**
    lilac and honeysuckle: powdery mildew
    poplars and willows: Melampsora leaf rusts
15. **Leaf lesions, with hornlike structures, mainly on undersurface of leaf**
    apples, hawthorn and Juneberry: cedar-apple rust
16. **Leaves develop early fall color, sparse foliage**
    chokecherry: western x-disease
17. **Leaves yellowing between veins, veins remain green**
    maples, and others: chlorosis, mineral deficiency
18. **Leaf margins scorched, all species, especially linden and maples**
    leaf scorch from hot winds, salt damage
19. **Leaf petioles with marble like galls on them**
    cottonwood and poplars: poplar petiole gall aphids
20. **Frothy mass of spittle containing a small insect**
    many species: spittlebugs

II. INJURY TO TWIGS OR NEW SHOOTS

A. Shoots dying, deformed or stunted

1. **Shoots and leaves dying or deformed**
   many species: aphids, herbicide damage
2. **Witches' brooms**
   honeysuckle: honeysuckle aphid
   Juneberry: black leaf witches' broom
   oak: oak anthracnose
3. **Shoots ending a with a brain shaped gall**
   cottonwood: vagabond aphid gall
4. **Cauliflowerlike growth behind, or over buds**
   poplars: poplar bud mite gall
5. **Black clusters hanging from twigs, green ash: ash flower gall mite**
6. **Large globular galls on twigs**
   rose: rose twiggall
   oak: oak bullet gall
7. **Twig terminating in a cone like structure**
   willows: pine cone willow gall
8. **Swollen area on small twigs**
   boxelder: boxelder twig borer
9. **Twigs dying, leaves blackened**
   apples, cotoneaster: fire blight
   Juneberry: black leaf witches broom

III. INJURY TO TRUNKS OR LARGER BRANCHES

A. Injury to branches

1. **Entire branch dying**
   American elm; Dutch elm disease, native elm wilt
   apples, mountain ash, cotoneaster: fireblight, black rot cankers
   ____ Hypoxylon canker
   chokecherry, Western X-disease
   green ash: Western ash bark beetle
   poplars: Septoria, Cytospora or Dothichiza cankers
   Russian olive, Siberian elm: Botryodiplodia or tuberculariа canker
   many species: various canker diseases
   prunus: Valsa canker
2. **Branches or trunk with small immobile spot like structures that can easily be dislodged, may occur singly, in irregular patches or cover large areas, color varies with the species, (scale insects)**
   poplars: scurfy scale(white), San Jose scale(grey)
   American elm: European elm scale
   many hardwoods: lecanium scale (large-dark-brown), oystershell scale (small, elongate, greyish-brown)
3. **Elongate thick blackish growths on branches**
   chokecherry, prunus: black knot
4. **Holes in trunk, often associated with sawdust green ash: ash borer, carpenterworm**
   poplars: poplar borer, bronze poplar borer
   oak: two lined chestnut borer
   birch: bronze birch borer
   many hardwoods: poplar/willow borer, pigeon tremes
5. **Regular sized rows of holes in the bark of the main trunk or large branches**
   many species: sapsuckers (a woodpecker)
6. **Small regular tunnels under the bark, or shotbole pattern in the bark (bark beetles)**
   American elm: native elm bark beetle, European elm bark beetle
   green ash: Eastern ash bark beetle,
   chokecherry, prunus: peach bark beetle, shothole borer (bark beetle)
7. **Trunks or crotches oozing foul smelling sap, may kill vegetation where it drips**
   elms, poplars: bacterial wetwood (slime flux)
8. **Trunks with shelf like or hoof-shaped growths green ash:**
   Perennipora (Fomes), heart rot fungus
   buffaloberry: Perennipora, heart rot fungus
9. **Burl-like or gall-like growths on trunks and larger branches**
   cottonwood and poplars: Diplodia gall and rough bark of poplars (a fungus disease)
10. **Dead areas of bark extending vertically, usually on the south or west sides of main trunks**
    mountain ash, maples, lindens, Malus and others: sunscald, mainly due to late winter low angle sun
11. **Uniform dieback of top branches**
    all species: usually associated with root injury or death. Some common causes of root dieback are: oxygen starvation due to soil compaction or poor drainage, excessively dry soil, chemical damage, or mechanical injury, girdling roots (see below). Insects or diseases are only rarely responsible for significant root injury.
12. **Bark on branches and/or main trunk blackened**
    American elm, and rarely other hardwoods
    sooty mold fungus growing on "honeydew" produced by sapfeeding insects, most commonly wooly elm
    aphids and European elm scale on American elm.

IV. ENTIRE TREE DYING

A. Dying with leaves on

American elm: Dutch elm disease
oaks: two lined chestnut borer
birch: bronze birch borer
chokecherry: Western X-disease (may not leaf out)
many species: girdling by: canker diseases, small rodents, beavers, or porcupines, mechanical damage from: lawn mowers, string trimmers, weed barriers
Trees may be girdled by their own roots, this may be indicated by a lack of root flare above the girdling portion of the roots of larger trees.

NORTH DAKOTA

FOREST PEST CONDITIONS
AND
SURVEY REPORT

by

Arden Tagestad

NORTH DAKOTA FOREST SERVICE

Bottineau, North Dakota

December 1991

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INTRODUCTION

From early May until October of 1990 and 1991, state-wide surveys for insect and disease pests of native and planted trees and shrubs were conducted in North Dakota. With the aid of USDA-Forest Service funding, over 250 locations were inspected and more than 250 landowners were contacted in each of the two years. Technical assistance was also provided on pest identification, evaluation and control. This report summarizes forest insect and disease conditions for North Dakota in 1990 and 1991.

SURVEY METHODS

Pest survey methods included examination of representative samples from all the major types of forest resources found in the state. Field investigations were conducted in native forests; shelterbelts; park and recreation areas; urban forests and other forested areas. The incidence of forest pests was recorded for each location. Special emphasis was placed on those pests recognized by resource professionals as having the greatest potential for causing significant damage to tree and shrub resources.

Particular attention was given to the incidence and impact of ash bark beetles and other wood boring insects. Drought conditions across the state made trees more vulnerable to attack by bark beetles and other insects that would normally be considered secondary. Moisture levels returned to near normal in most areas of the state in 1991, but effects of the drought on the trees will persist for many years to come. Opportunistic insects and diseases will continue to take advantage of stressed trees which may take as much as ten years to fully recover...and many never will.

Technical assistance including identification, evaluation and control recommendation was provided to private landowners and resource managers when requested. Training on forest pest management was also given to North Dakota Forest Service employees. In addition, 231 people were given training in 1990 and 354 attended training sessions in 1991. Survey information was presented to interested individuals and agencies involved in resource management in an effort to speed up information exchange. The North Dakota Urban and Community Forestry Association, North Dakota Farm Forestry and the North Dakota Christmas Tree Grower's Association were given updates at their regular meetings when possible.

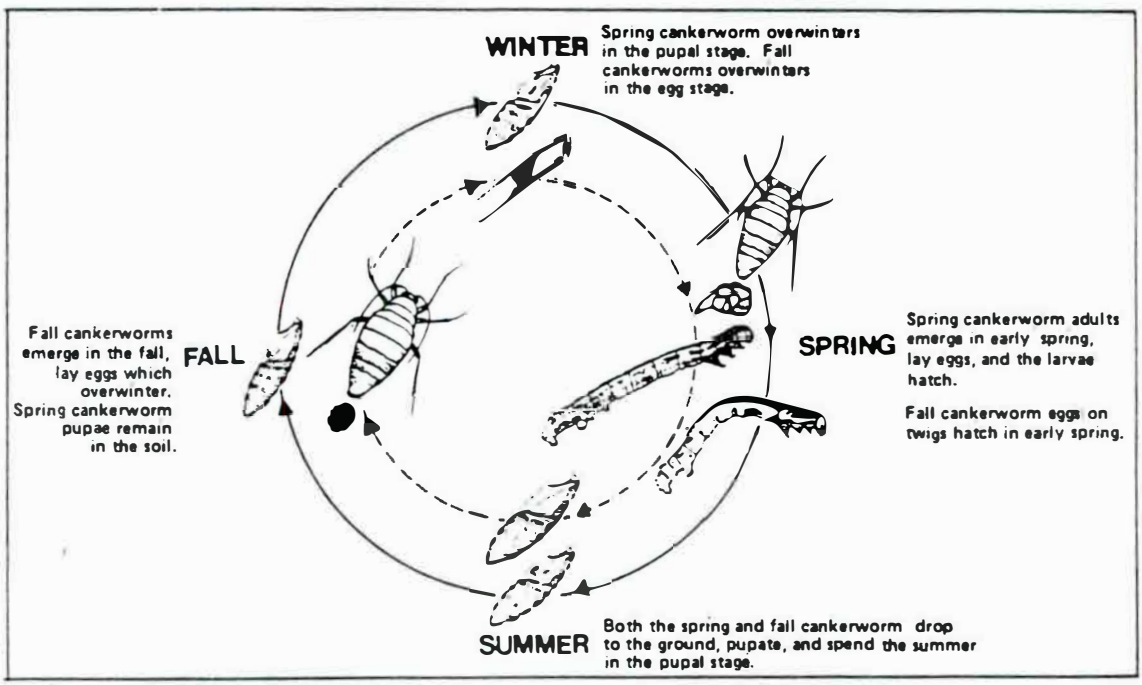
RESULTS

In each of the two field seasons, forest insect and disease conditions were evaluated in more than 250 locations across the state. More than 500 people, many seeking aid in pest identification and evaluation, were contacted in the two years. Considerable time was spent visiting groups with special interests in forest pest problems. Included were visitations to city foresters, park supervisors, nurserymen, researchers, SCS district conservationists, plant material specialists, North Dakota Game and Fish Department personnel and North Dakota Forest Service district foresters.

In addition to the public contacts made through this survey, North Dakota Forest Service personnel responded to 265 requests for forest pest management assistance in 1990 and 284 in 1991. Requests came primarily from community officials, home owners, private woodland owners and federal agencies. The majority of these requests required on-site evaluation of forest pest conditions and, in some cases, making control recommendations.

SPECIFIC PESTS

The following text describes the specific forest pests most commonly encountered in 1990 and 1991. Tables I and II contain more extensive lists rating each by present and potential importance.


WINTER
Spring cankerworm overwinters in the pupal stage. Fall cankerworms overwinters in the egg stage.
SPRING
Spring cankerworm adults emerge in early spring, lay eggs, and the larvae hatch.
Fall cankerworm eggs on twigs hatch in early spring.
SUMMER
Both the spring and fall cankerworm drop to the ground, pupate, and spend the summer in the pupal stage.
FALL
Fall cankerworms emerge in the fall, lay eggs which overwinter. Spring cankerworm pupae remain in the soil.

Life Cycle of Spring and Fall Cankerworm

BORERS AND BARK BEETLES

Ash Bark Beetles (a/k/a White-banded Ash Bark Beetle) - Green ash, black ash

In the past, a number of resource managers have reported that relatively healthy green ash were being attacked, overwhelmed and killed by mass attacks of the ash bark beetle in the genus Hylesinus (formerly Leperisinus). This type of damage and mortality was found, but the numbers of incidences were low and few trees are killed in this manner, certainly less than 1.0 % statewide. All members of genus Hylesinus are considered secondary; that is they attack trees severely weakened by drought, suffering from lawn mower damage, soil compaction or other stresses. Because of the drought conditions experienced since 1988, increased losses have been seen. More favorable moisture conditions in 1991 reduced losses to pre-drought period levels.

More than one species is involved, but the primary species implicated is the Eastern Ash Bark Beetle, Hylesinus aculeatus.

One member of the genus, Hylesinus californicus. The western ash bark beetle, damages green ash across the state. Younger, newly moved ash trees in parks, recreation areas and highway department plantings were especially hard hit. Stressed trees in any size class may be infested.

The western ash bark beetle, however, does not attack the main trunk of the tree en masse. This species prefers to attack live trees under stress, inflicting damage to individual limbs or the main stem in the crown. Formation of the brood gallery, which encircles the branch, usually kills the branch or main stem from the point of attack outward. This species tends to re-infest the same trees year after year, progressively killing younger trees from the top downward. In larger trees, the crowns are progressively thinned until the tree looses its vigor, aesthetic value and ability to break the wind.

Pine Bark Beetle Complex (Ips and Dendroctonus) - Ponderosa pine

In July, 1988, scattered groups of recently killed trees were found in a native stand of ponderosa pine in Slope County. Closer inspection revealed groups of two to ten trees killed by bark beetles. These bark beetles were found to be in the genus Ips, commonly referred to as engraver beetles. This was the first time bark beetles had been reported to be killing ponderosa pine in the area.

The most prevalent species is the six-spined ips, Ips Calligraphus. Two other bark beetle species, the pine engraver, Ips pini, and the red turpentine beetle, Dendroctonus valens, were also present. The latter two were not detected in every tree. None of the three is considered highly aggressive, but each is capable of killing trees weakened by other factors. A long-horned wood borer, tentatively identified as the white-spotted pine sawyer, Monochamus scutellatus, was found in a large percentage of dead and dying trees. The pine sawyer damages dying or recently dead trees by burrowing under the bark and into the sapwood and heartwood. Commonly, this damage renders the wood unsuitable for wood products. Significantly, the highly aggressive mountain pine beetle, Dendroctonus pondersae, has not been found. Populations since 1988 have persisted at relatively low levels, this is probably due to locally more favorable moisture levels. With continued periods of drought, Ips and

Dendroctonus bark beetles are likely to build up rapidly and severely damage our only native pine area.

Ash Borer (Lilac Borer) - Green ash, black ash

Present in young green ash statewide, the ash borer was most numerous in the southwest and south central areas of the state. Moderate populations were found in street trees in several cities and shade trees in parks, recreation areas and highway department plantings, especially in locations south and west of the Missouri River. Light to moderate infestations were noted in shelterbelts surrounding the Bowman-Haley Dam Reservoir.

Carpenterworm - Green ash, hybrid poplars, and Siberian elm

Light to moderate populations appeared in green ash in southwest, south central, and northwest North Dakota. Light to moderate populations also occurred in hybrid poplars in south central and southwestern North Dakota. Moderate damage occurred in the shelterbelts surrounding Bowman-Haley Reservoir. Larger green ash was the preferred host, with lesser populations in Siberian elm and hybrid poplars. Severe damage is common in both planted and native green ash south and west of the Missouri River.

Poplar Borer - Aspen, cottonwood, and hybrid poplars

The poplar borer was most numerous in hybrid poplars in south central and southwestern North Dakota in parks and urban areas. Oftentimes, both the poplar borer and carpenterworms were present in the same trees (see carpenterworm).

Ironically, the least affected species seems to be the eastern cottonwood which has seldom been planted in recent years. This pest was also present in native aspen, causing extensive damage to open grown trees and trees along edges of fields, roads or lakes. Because the poplar borer seems to show a preference for laying its eggs in sunny locations, it may be wise to delay or avoid pruning hybrid poplars if possible.

Bronze Birch Borer - Birch

Bronze birch borers continue to attack birches statewide, especially the cutleaf weeping birch weakened by drought or other factors. Drought conditions in 1990 and 1991 have predisposed many birch to attack, and there is likely to be an increase in the number of trees damaged over the next several years. Bronze birch borer infestations may be contributing to a decline of native birch in the Turtle Mountains in Bottineau and Rolette Counties, the Pembina Hills in Cavalier County and the Killdeer Mountains in Dunn County.

Tip Borer - Scotch pine

In 1989, larvae thought to be a species of Dioryctria were found tunneling in and killing the current year's growth, usually terminals, on Scotch pine. These insects were detected in McHenry, Cavalier, and Pembina Counties. Highest populations were in Christmas tree plantations in Pembina County. The status remains about the same, populations have not increased significantly. Because terminals are killed, this insect could be of major concern to Christmas tree growers if it would occur in high numbers.

Tip Moth - Scotch and ponderosa pine

The tip moth was most numerous on ponderosa pine in the south central and southwestern areas of North Dakota. It may occasionally be found in the north central and northwestern areas of the state. The most severe damage was present on young tree reproduction in native stands in Slope County. Rarely has tip moth damage been observed north and east of a line extending from Crosby in the northwest to Ellendale in the southeast.

Two-Lined Chestnut Borer - Bur oak

In August of 1990, Sully's Hill Game Management Area near Devils Lake reported large numbers of bur oak dying. The trees were heavily infested and were being killed by two-lined chestnut borer. Other areas that had a heavy tree kill in 1990 and 1991 were near Bismarck, Taylor, in the Turtle mountains north of Bottineau and the Rolla/St. John area. Heaviest losses overall were in the Edinburgh to Walhalla areas. As the 1991 season progressed, it became evident that tree kill would be reduced compared to the 1990 season. The more favorable moisture conditions in 1991, no doubt, allowed the trees to resist attacks to a greater degree. There are still lots of sick trees out there that will continue to die even with average moisture. Drought conditions would hasten their death. Statewide a very small percentage of the oaks were killed or seriously injured. But, because dead trees occurred in groups and many acres may be dead in a particular area it often made for a very dramatic scene.

Metallic Pine Pitch Nodule Maker - Ponderosa, lodgepole, and Scotch pine

The metallic pine pitch nodule maker was found statewide on ponderosa pine. Heaviest populations recorded were in the south central and southwest regions, but populations were low in the north central and northeastern areas. A lodgepole pine provenance planting on the A.R.S. station grounds in Mandan has a low population. Incidence on Scotch pine was restricted to a few attacks in one planting in Dickey County near Ellendale. In spite of the fact that this insect commonly attacks Scotch pine in Saskatchewan, it rarely attacks Scotch pine in North Dakota.

HARDWOOD DEFOLIATORS

Cankerworms - Elms, boxelder, green ash, lindens, bur oak and hackberry

Again in 1990 and 1991, the perennial problem of complete defoliation of single row Siberian elm belts by spring cankerworm was noted in many single-row Siberian elm plantings across North Dakota. Lesser amounts of damage could be found in a high percentage of the remaining belts across the state. Fall cankerworm has been noted in single row green ash belts in several areas in widely separated locations in east central, north central and southwest North Dakota. Fall cankerworm occurs across the state and complete defoliation of green ash, boxelder and bur oak was common in both native stands and planted windbreaks.

An additional problem is high populations of the fall cankerworm occurring simultaneously with spring cankerworm in some areas, notably the Missouri and Souris River drainages and the Devils Lake area. Where both species occur, spring cankerworm defoliate elms and the fall cankerworm defoliates green ash, boxelder, lindens and hackberry. In some instances, even understory shrubs are completely defoliated after the foliage of the overstory trees is consumed. Where only spring cankerworm exist, green ash, boxelder and understory shrubs usually escape heavy defoliation. Fall cankerworm has been noted in single row green ash in several areas.

Common associates of both species, especially in native areas are three other geometrid loopers, the linden looper, elm spanworm and the half wing geometer.

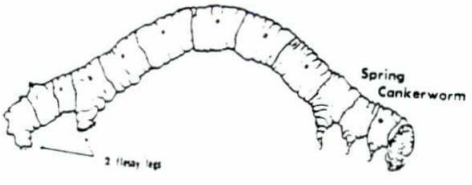
Populations of all species seem to rise and fall independent of each other in native, planted or urban areas.

Prairie Tent Caterpillar - Chokecherry, prunus, and wild rose

The prairie tent caterpillar was common to locally abundant in the western two-thirds of the state. Chokecherry and wild rose are the preferred native species. Prairie tent caterpillar attacks occur in cities on prunus and apple species. Usually, very little actual defoliation occurs, but controls measures are often taken because people consider the nests unsightly.

Pear Slug - Cotoneaster and prunus

The pear slug has often caused complete defoliation of cotoneaster statewide. The central and north central areas of the state were especially hard hit. Pear slugs skeletonize leaves by consuming the upper surfaces causing the damage to superficially resemble fire blight injury. Consequently, the two pests are often confused.



CONIFER DEFOLIATORS

Introduced Pine Sawfly - Scotch and ponderosa pine

Scattered light to moderate infestations of introduced pine sawfly were noted on ponderosa and Scotch pine, mostly in the western half of the state.

Larch Sawfly - Siberian larch

The infestation level of larch sawfly on one plantation of Siberian larch at the Denbigh Experimental Forest has remained very high since 1987. The infested trees were sprayed in early June, 1988, with the insecticide Sevin 805 to reduce the population. The control measures were successful. Population levels remained low in 1990 and control measures were not necessary.

SAPSUCKING INSECTS AND MITES

Ash Plant Bug

Damage by the ash plant bug was noted in planted and native ash statewide. Moderate to heavy damage was noted in all size classes of ash, but the most serious damage was to young trees, especially those stressed by other factors.

Honeysuckle Witches-Broom Aphid - Tatarian honeysuckle

Honeysuckle aphids seriously damaged Tatarian honeysuckle statewide, effectively stopping new growth and reducing the usefulness of Tatarian honeysuckle. The seriousness of the infestation makes further usage of the Tatarian honeysuckle questionable.

Aphids - Many species of trees and shrubs

Severe damage was noted on aspen, hybrid poplars, oak, chokecherry, boxelder, green ash, American elm, snowball viburnum, spruces and Scotch pine. Aphid populations can rise very quickly and then, oftentimes, abruptly decline from predation, especially by ladybird beetles and their larvae. Detection of aphids requires close inspection on a regular basis. The presence of ants on the foliage generally means aphid infestation of the plant. Treatment may be required on young trees, especially if new growth is being affected and feeding damage threatens the form or vigor.

Giant Conifer Aphid - Scotch pine and ponderosa pine

The giant conifer aphid was locally abundant on Scotch pine in south central and southwestern North Dakota. The insect was also present on Scotch and ponderosa pines, primarily in the western half of the state.

Pine Needle Scale - Pines and spruces, especially muhgo pine

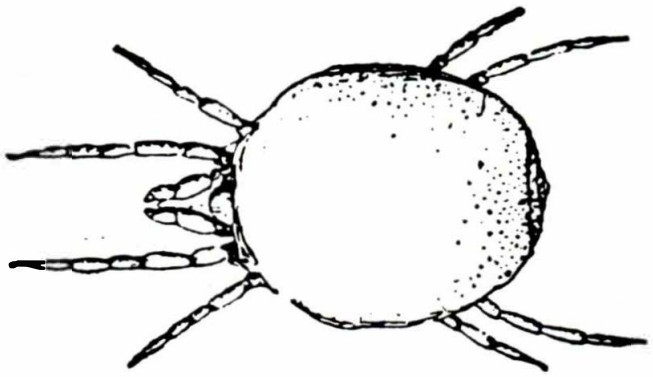
The highest populations of pine needle scale were in the north central and south central areas of the state on muhgo pine and Black Hills spruce. Infestations are often missed because of the difficulty of associating the tiny white specks with insect damage.

Spruce Spider Mite - Spruce, juniper, and arborvitae

High populations of mites were found in scattered locations throughout the state. Generally, mites are restricted to localized protected areas and are not likely to be found uniformly over an entire large tree. Smaller trees are more likely to be seriously infected.

Hot dry weather, such as we experienced in the spring and summer of 1988 and 1989, allows mites to build to high numbers. Cool weather slows their development. Rain and high winds often dislodge the mites and their eggs. Open grown trees and shrubs are seldom seriously infested. Foundation shrub plantings are the most seriously affected, especially those sheltered by buildings or other types of structures. Plants that are located on the south and west sides of buildings where temperatures are greater are at a higher risk. Spider mites prefer low-growing ornamental junipers. A separate species, the two-spotted mite, is often found on hardwood shrubs.

Diagnosis is difficult and spider-mite damage is often confused with winter drying, drought stress, or other factors. Due to this mis-diagnosis, much needless spraying is done. This spraying may actually contribute to population buildups by eliminating predators.



Spider mites

GALL MAKING INSECTS AND MITES

Ash Flower Mite Gall - Green ash

Appeared on male ash trees statewide, very noticeable in the winter when the galls turn black and persist on the trees. Although they are unsightly, the galls cause little, if any, actual damage to the trees. Occasional damage by this mite occurs on female flowers or on the leaves.

Poplar Bud Gall Mite - Cottonwoods and other poplars

Occurs statewide, found primarily on cottonwood and northwestern poplars and is particularly abundant on northwestern poplar. The poplar bud gall mite may cause stunting, crooked growth and rarely death of younger stressed trees.

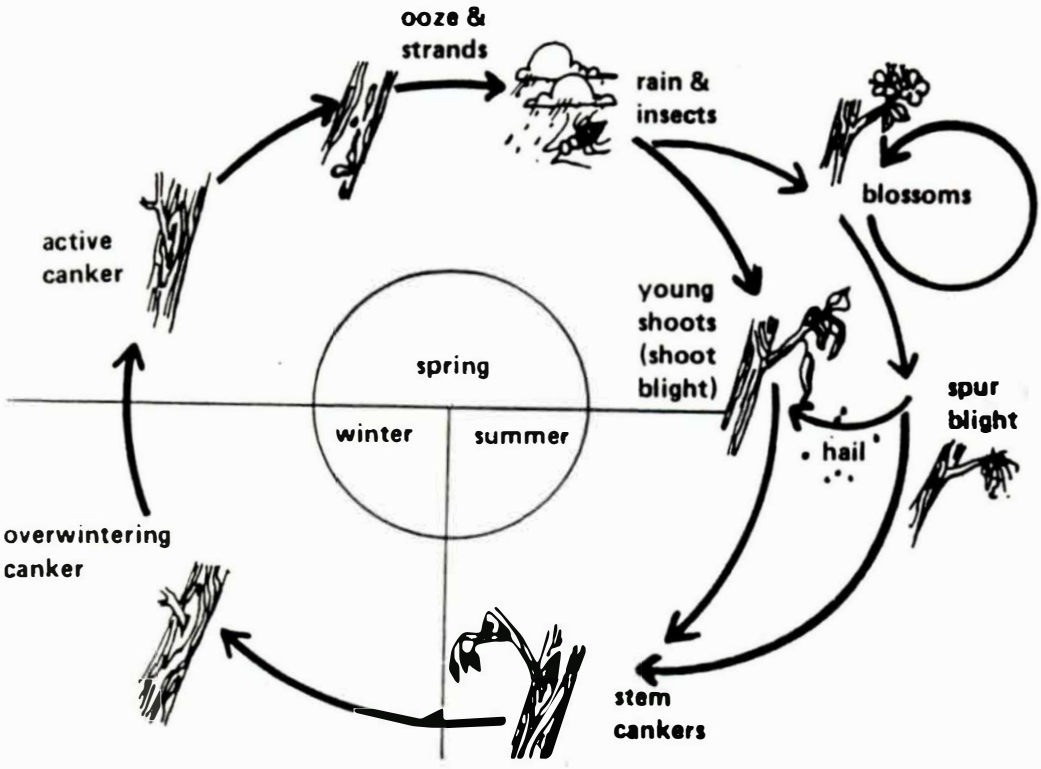
Poplar vagabond aphid - Cottonwoods and other poplars

Occurs statewide, primarily objectionable because the relatively large galls persist throughout the season and are very noticeable after leaf drop. In reality, the trees suffer little, if any, actual physiological damage.

Oak Bullet Gall - Bur oak

This gall was discovered to be abundant in Williston. Some individual trees had large numbers of galls on nearly every branch. Because the galls persist on the trees for up to five years, the resulting accumulation of galls is very unsightly. This gall is a potentially serious pest of bur oak in ornamental plantings.

DISEASES



Fire blight life cycle.

HARDWOOD DISEASES

Dutch Elm Disease - American elm

Increases in Dutch elm disease (DED) were noted in native populations of elm during 1988 and 1989. There seemed to be accelerated losses from DED associated with the drought conditions. The exact reasons are speculative, but probably are due to a loss of vigor of native elms and the resulting increase in suitable brood wood for the native elm bark beetle, the principal vector of DED in North Dakota. As of 1991, DED can be found in all of our native forests in the state. Some smaller pockets of native elm, or where the trees are scattered or occur in small groups, have escaped injury to date. Windbreak plantings have not been seriously affected, except where they are proximate to native elm populations.

The level of disease was stable and, in some instances, even declined among cities with active sanitation and other management programs. The fate of elms in towns has varied widely. Towns isolated from major river valley tributaries, where infested native elm stands occur, have generally escaped serious losses. Once a tree has DED it cannot be cured, but losses can be reduced to minimize the impact. Cities located in native elm areas that do not promptly remove infected trees and ignore elm firewood piles are hardest hit. As the disease runs its course in native elm and the number of infested elms in these areas declines, cities in the river valleys will see a decline in the number of trees lost to DED.

Western X Disease - Chokecherry

Western X disease symptoms occurred on native and planted chokecherry across the state. Symptoms include foliage which turns yellow or red in early summer, has smaller than normal leaves and lacks fruit or has fruit which does not ripen normally. Infected trees show a distinct rosetting of leaves on branch tips, progressive reduction in growth and eventually death.

Symptoms are present on common chokecherry in nearly every county, and are widely found on the ornamental chokecherry variety known as Canada red cherry (Shubert chokecherry). While many factors can cause chokecherry to exhibit some of the symptoms characteristic of Western X disease, the presence of all of the above described symptoms on the same stem indicates a very high likelihood that Western X disease is present. Laboratory diagnosis is difficult, but samples submitted by Jim Walla of North Dakota State University to Dr. Bruce Kilpatrick of the University of California-Davis confirmed Western X-disease present in Bottineau, Burleigh, Cass, Grand Forks and Pembina Counties.

Fire Blight - Apple, crabapple, pear and cotoneaster

Fire blight was present statewide and remains a serious threat in susceptible varieties of apples and ornamental crabapples. A trend towards planting less susceptible varieties has reduced the severity. Oftentimes injury may be restricted to the fruiting spurs instead of killing entire branches, but in some cases nearly every fruiting spur is affected. All of the major cities experienced high infestation rates. The more isolated plantings in small towns, parks or farmsteads were not as likely to be seriously injured. Siberian crabapple trees in windbreaks may be seriously affected.

Fire blight was found on cotoneaster statewide. An insect (see pear slug) causes symptoms which are often confused with fire blight. In the case of pear slug infestation, a close inspection will reveal skeletonizing on the upper surface of the leaf and the possible presence of larvae. While treatment with an insecticide is an effective control for pear slugs, no pesticide is currently registered for fire blight control on cotoneaster.

Poplar Canker - Cottonwood and hybrid poplars

Poplar cankers are an important cause of branch and stem mortality in hybrid poplars. Some poplar clones, especially those stressed by drought, other environmental factors or of borderline hardiness, are most seriously affected.

Siberian Elm Cankers - Siberian elm

Many shelterbelts, especially single-row, have been infected by cankers and are in a state of serious decline. These branch cankers are playing an important role in the deterioration process. Many miles of single-row Siberian elm shelterbelts are being removed each year, few are being replaced.

Russian Olive Cankers - Russian olive

Russian olive, especially shelterbelts in cultivated areas, continue to be plagued by branch dieback from cankers. Cankers seem to be more numerous on trees near cereal crops. This higher incidence may be related to more frequent direct exposure of trees to herbicides such as 2,4-D. Many healthy trees, some of them large and obviously quite old, continue to thrive in cities and parks where they have more room to grow and their exposure to crop sprays is lessened.

Black Knot - Chokecherry and Mayday

Black knot disease appears to be on the increase on ornamentals prunus in cities. Canada red cherry is often attacked. When the diseased branches are not trimmed out, the incidence of disease increases year to year. Mayday trees seem to be particularly vulnerable and many have been removed because of deformities caused by black knot.

Native chokecherry is infested with black knot disease statewide. Some chokecherry clones are heavily infected with one or more knots present on nearly every branch. Where heavily infected chokecherry are in close proximity to ornamental varieties of prunus, diseased plants should be removed.

Wetwood (Slime Flux) - Cottonwood, hybrid poplar and elm

A high percentage of cottonwood, hybrid poplar and elm trees over approximately 30-years old are infected with bacterial wetwood. Outward signs of the disease are not always obvious. When wetwood toxins are transported into the branches of a tree's crown, wilting of the leaves may occur. Branch dieback and general tree decline can result. In some instances, wetwood has been judged to be the primary cause of decline or death of trees.

CONIFER DISEASES

Rhizophaera Needlecast - Blue spruce

Rhizophaera needlecast on spruce was most prevalent in the eastern regions of the state. Rhizophaera needlecast is rarely found in the western half of the state. Most seriously affected are spruce grown in crowded conditions, open grown trees are rarely injured.

Lirula Needlecast - Black Hills and white spruce

Lirula needlecast disease was found primarily in north central, northeastern, and southeastern portions of North Dakota. A planting on the Wakopa Game Management area in Rolette County sustained light to moderate damage. Needlecast of spruce are more likely to affect sheltered trees (see Rhizophaera).

Unknown Tip Dieback - Scotch, mugho and ponderosa pines

In 1988, 1989 and 1990, a characteristic tip dieback symptom was found on pines in Bottineau, Burleigh, McLean, Mercer, Morton, Ramsey, Rolette, Walsh and Ward Counties occurring on the current year's growth. In some cases, the entire year's growth was dead. In other cases, all needles and bark tissue beyond a certain point were dead. No sign of insect activity or disease damage could be found. The symptoms closely resembled Cenangium dieback of pines, but nothing could be cultured out of the samples. With the return to more normal moisture conditions in 1991, this type of injury was rarely observed. This leads me to believe that a weak opportunistic fungus was involved, but the mystery remains.

Diplodia Tip Blight - Ponderosa pine

In 1988 and 1989, Diplodia tip blight was identified on trees at the Denbigh Experimental Forest in McHenry County, the A.R.S. station grounds in Morton County, a private residence in the city of Dickinson and on native pines at the Logging Camp Ranch in Slope County. All of the infested trees were over 40-years old. The Morton County shelterbelt is one of the oldest ponderosa pine plantings in the state. The disease spores were isolated from second year cones. In 1990 and 1991, Diplodia became much less prevalent.

Cytospora Canker - Spruce

Cytospora canker caused damage to spruce mostly across the eastern two-thirds of the state. Older trees or trees stressed by sod competition, drought or root injury are especially susceptible to this canker. Any serious decline in the health of a tree may allow invasion of the organism. Infestations generally start with branches near the bottom of the tree. Crowding in the row or by adjacent trees has been implicated as a predisposing factor.

Western Gall Rust - Ponderosa and Scotch pines

Western gall rust was found in pine plantations in McHenry, Bottineau, Pembina, Mercer and Morton Counties; several shelterbelts scattered throughout the state and in native ponderosa pine in Slope County. The incidence of this disease is on the rise in planted ponderosa pine.

Sooty Mold - Ponderosa pine

Sooty mold was found in a pine plantation in the Denbigh Experimental Forest in McHenry County and one in Bottineau County. In both cases, trees were crowded restricting both air movement and sunlight penetration. The mold gives affected needles a dusky, dark grey color. Although unsightly, it is not thought to cause death of the infected needles.

ABIOTIC FACTORS

Herbicide Damage - Many species

Herbicide injury has become an increasing problem for many tree species during recent years. In addition to the more "traditional" phenoxy herbicide injury (2,4-D drift), there has been increased damage from pre-emergent sprays. The list of approved herbicides for use on trees, shrubs, field crops and ornamentals grows every year. In some cases, injury symptoms of these herbicides on tree species is unknown. In addition, the source of the chemicals may not be obvious. Potentially harmful herbicides are sometimes added to "weed and feed" type lawn fertilizers or they may leach into the root zone of trees from nearby crops. Where variable soil and weather conditions exist, the application of herbicides according to label recommendations may cause injury to nearby trees.

Boxelder, Siberian elm, Amur maple and grape are particularly sensitive to 2,4-D injury. Direct herbicide application is not always necessary for these plants to show damage symptoms. Phenoxy herbicide injury has been implicated in the decline of Siberian elm, notable in single-row belts. Cottonwood seems to be especially sensitive to root injury by Tordon and other soil-applied chemicals. Extreme care and constant vigilance is needed to prevent herbicide and other chemical damage to trees and shrubs.

Fertilizer Damage - Many species

Conifers, especially spruce in highly-fertilized lawns, seem to be more prone to winter damage. It is suspected that late summer or early fall applications of nitrogen keep them from going dormant when they should. No doubt, the same type of damage occurs on deciduous trees and shrubs but is not as recognizable as damage to conifers.

Drought Damage

Very hot and dry conditions in 1988 and 1990 affected all trees and shrubs in the state in some manner. Newly planted trees, especially field windbreaks and others which did not receive supplemental watering, often exhibited lower survival. Trees under stress from insect attack or disease, severe competition by sod or overcrowding were killed by the drought. Many trees of all species, especially those less drought tolerant, were put into decline and losses will occur for several years to come.

Stressed trees are more prone to attack by insects and disease. Boring insects and bark beetles favor dry periods and weakened trees. Stressed trees are less able to resist invasion by canker causing fungi. In spite of better growing conditions in 1991, many trees will continue to decline. Effects of the drought will linger for several years to come.

Sapsuckers and other woodpeckers

Sapsucker damage occurs most commonly on medium to large trees, but small pines are commonly injured. Open areas of bark between whorls of branches are most often attacked. Damage consists of evenly spaced rows of holes which may extend all the way around the trunk. Because the holes are close together sap flow is interrupted and the stem is girdled above the point of injury. Sapsuckers are known to nest in the Turtle Mountains, Pembina Hills and other large tracts of native woodlands in the state.

Damage may occur any time during the migration or breeding period in these regions. In the remainder of the state injury occurs only during the migration period.

Other species of woodpeckers excavate holes when they attempt to reach insect larvae that are tunneling in the wood or under the bark. These efforts, when noticed by humans, are oftentimes not appreciated and misinterpreted as willful damage by woodpeckers to trees. In some cases, the woodpecker pays with its life instead of being praised for its efforts to remove insect pests. Misguided home owners kill the birds not realizing that the woodpeckers are actually doing them a favor. Woodpeckers do not go around randomly drilling holes in trees! If woodpeckers are tunneling in your tree, insects are present. Tunneling activity uses up huge amounts of energy, and woodpeckers would not survive if they used this energy unwisely, especially in the winter. They must find high energy insect larvae to survive. The exception is when woodpeckers are excavating their nest holes. Even then, they choose trees with heart rot. Woodpecker activity should be used by home owners and other resource managers as a tip-off that their trees are severely stressed and wood boring insects have taken notice. Or in the case of nest holes, that heart rot or rotten areas are present.

Table I

INCIDENCE AND POTENTIAL IMPORTANCE OF PESTS COMMONLY OCCURRING IN NORTH DAKOTA

KEY TO PLANTING TYPE AND DAMAGE RATING

Type of Forest or Planting

URB - Urban
SHL - Shelterbelts
PRK - Parks
NAT - Native

Present Incidence

1 - High Population
2 - Moderate Population
3 - Low Population
4 - Present, but insignificant

Potential for increased or Sustained High Populations

A - Highly likely
B - Moderately likely
C - Not likely

PEST/HOST	CATEGORY AND DAMAGE RATING	COMMENTS
DEFOLIATING INSECTS		
Ash grey blister beetle/ caragana	URB-3B, SHL-2B, PRK-2B	
Aspen leaf roller/ native aspen	PRK-4C, NAT-3B	
Blackheaded ash sawfly/ green ash	URB-4C, SHL-4B, PRK-4B, NAT-4B	
Cercropia moth/green ash, boxelder, lilac, chokecherry	URB-4B, SHL-3B, PRK-3B, NAT-4B	
Cottonwood leaf beetle/ poplars, willows	URB-3B, SHL-4B, PRK-3B, NAT-3B	
Elm leaf beetle/ Siberian elm	URB-2A, SHL-4A, PRK-3A, NAT-3C	
Elm sawfly/elms, white willow	URB-4B, SHL-3B, PRK-3B, NAT-4B	
European pine sawfly/ Scotch pine	URB-4B, SHL-3B, PRK-3B	

PEST/HOST	CATEGORY AND DAMAGE RATING	COMMENTS
Fall cankerworm/ green ash, boxelder	URB-3B, SHL-3B, PRK-3B, NAT-2B	
Fall webworm/elms, prunus, populus,	URB-3C, SHL-3B, PRK-3B, NAT-2B	Most numerous SW and SC
Forest Tent caterpillar/ aspen, ash, apples	URB-3B, SHL-4C, PRK-2B, NAT-3A	urban pest in larger cities
Fruit tree Leaf Roller/ green ash	URB-3B, SHL-4B, PRK-3B, NAT-4C	
Grasshoppers/caragana	URB-4C, SHL-2A, PRK-2A	
Great ash sphinx/ green ash	URB-4B, SHL-4C, PRK-4B, NAT-4C	
Introduced pine sawfly/ ponderosa & Scotch pine	URB-4B, SHL-3B, PRK-3B, NAT-4B	
Larch sawfly/Siberian larch	URB-4A, SHL-4A, PRK-3A	
Leaf crumpler/cotoneaster, hawthorne	URB-3B, SHL-3B, PRK-3B	
Linden looper/elms, boxelder, prunus	URB-3B, SHL-3B, PRK-2B, NAT-3B	commonly found with cankerworm
Mourningcloak butterfly (spiny elm caterpillar)/ elms	URB-3B, SHL-3C, PRK-2B, NAT-4C	
Pear slug/ prunus, cotoneaster	URB-1A, SHL-2A, PRK-2A, NAT-3B	Especially in central & west on cotoneaster
Red humped oakworm/ bur oak	URB-4C, SHL-4C, PRK-4B, NAT-3B	
Spring Cankerworm/ elms	URB-2A, SLH-1A, PRK-2B, NAT-2B	
Spruce budworm/spruces	URB-4B, SHL-4B, PRK-4B	
Ugly nest tent caterpillar/chokecherry	URB-4B, SHL-3B, PRK-3B, NAT-3B	
Variable oak leaf caterpillar/burr oak	URB-4C, SHL-4C, PRK-4B, NAT-4B	

PEST/HOST	CATEGORY AND DAMAGE RATING	COMMENTS
Yellow-headed spruce sawfly/spruces	URB-4B, SHL-4B, PRK-4B	NC & NE
HARDWOOD BORERS, BARK BEETLES, AND LEAF MINERS		
Ash borer/green ash lilacs,	URB-2A, SHL-3B, PRK-2A, NAT-3B	Mostly young trees to 6" diameter
Ash & privet borer/ green ash	URB-3B, SHL-3A, PRK-3B, NAT-3B	
Boxelder twig borer/ boxelder	URB-2A, SHL-3A, PRK-3A, NAT-3B	
Bronze birch borer/cutleaf weeping birch, other birches	URB-1A, PRK-1A, NAT-2B	
Bronze poplar borer	URB-3B, SHL-3B, PRK-3B, NAT-4C	
Carpenterworm/green ash,	URB-3B, SHL-3B, PRK-2A, NAT-3B	Mainly larger trees over 6" diameter
Cottonwood borer/ cottonwood, poplars	URB-4C, SHL-4C, PRK-4B, NAT-4C	
European elm bark beetle/elms	URB-4B, SHL-4B, PRK-4B, NAT-3B	
Native elm bark beetle/ American elm	URB-2B, SHL-2B, PRK-2B, NAT-1A	
Peach bark beetle/ chokecherry, Juneberry, Mt. ash	URB-3B, SHL-2B, PRK-3B, NAT-3B	In dying trees
Peach tree borer/ prunus	URB-4B, SHL-3B, PRK-3B, NAT-3B	
Poplar borer/hybrid poplars, cottonwood, aspen	URB-3B, SHL-3B, PRK-2A, NAT-3B	Prefers open grown trees
Poplar and willow borer	URB-4B, SHL-4B, PRK-4A, NAT-3A	NC & NE
Shothole borer/ chokecherry, Juneberry, Mt. ash, hawthorne	URB-3B, SHL-2B, PRK-3B, NAT-3B	In weakened trees

PEST/HOST	CATEGORY AND DAMAGE RATING	COMMENTS
Two lined chestnut borer bur oak	URB-3B, SHL-4C, PRK-4C, NAT-2B	
CONIFER BORERS		
Larch case bearer	URB-4C, SHL-4B, PRK-4B	
Metallic pine pitch nodule maker/ponderosa pine	URB-3A, SHL-3A, PRK-2A, NAT-3B	
Pine needle sheath miner/ pines	URB-4B, SHL-3B, PRK-3B, NAT-4C	
Spruce needle miner/spruce	URB-4B, SHL-3B, PRK-4B	
Western pine tip moth/ ponderosa & Scotch pine	URB-4B, SHL-3A, PRK-2A, NAT-1B	SW & SC
Zimmerman pine moth/ ponderosa and scotch pine	URB-4B, SHL-4B, PRK-4B, NAT-4B	
SAPSUCKING INSECTS & MITES		
Ash plant bug	URB-2B, SHL-1A, PRK-2B, NAT-2B	
Caragana aphid/caragana	URB-3B, SHL-3B, PRK-2B	
Chokecherry aphid/ chokecherry	URB-2B, SHL-2A, PRK-1A, NAT-3B	
Elm lace bug	URB-4B, SHL-4B, PRK-4B, NAT-4B	
European Elm Scale	URB-2A, SHL-3B, PRK-3B, NAT-3B	
European fruit lacanium scale/elms, green ash, boxelder	URB-3B, SHL-4C, PRK-3B, NAT-4C	
Giant conifer aphid/ ponderosa & Scotch pine	URB-3B, SHL-4B, PRK-3A, NAT-4C	
Honeysuckle witches'-broom aphid/Tatarian honeysuckle	URB-1A, SHL-1A, PRK-1A	
Lace bug/cotoneaster & Juneberry	URB-3B, SHL-4B, PRK-3B, NAT-3B	

PEST/HOST	CATEGORY AND DAMAGE RATING	COMMENTS
Oak lace bug/Burr oak	URB-4C, SHL-4C, PRK-3B, NAT-1B	In native-oak areas
Oyster shell scale/prunus, cotoneaster, Juneberry	URB-2B, SHL-2B, PRK-2B, NAT-2B	
Pine needle scale/scotch & mugho pine, spruces	URB-2B, SHL-3C, PRK-2A	
Scurfy scale/ Poplars	URB-3B, SHL-3B, PRK-3B, NAT-4B	
Spruce Spider mite/spruce	URB-2B, SHL-3C, PRK-2B	Protected sites or drought periods
Woolly elm aphid/ American Elm	URB-2A, SHL-3A, PRK-2A, NAT-3B	
GALL MAKING INSECTS AND MITES		
Ash flower gall mite/ green ash	URB-2B, SHL-2B, PRK-2B, NAT-2B	
Hackberry nipple gall	URB-3A, SHL-3A, PRK-3A	
Oak Bullet Gall	URB-2A, SHL-3B, PRK-3B, NAT-4C	
Poplar bud gall mite	URB-3B, SHL-2B, PRK-2B, NAT-2B	
Poplar petiole gall aphid cottonwood	URB-3B, SHL-3B, PRK-3B, NAT-3B	
Poplar vagabond aphid gall/cottonwood	URB-3B, SHL-3B, PRK-2B	

Table II

INCIDENCE AND POTENTIAL IMPORTANCE OF DISEASES COMMONLY OCCURRING IN NORTH DAKOTA

KEY TO PLANTING TYPE AND DAMAGE RATING

Type of Forest or Planting

URB - Urban
SHL - Shelterbelts
PRK - Parks
NAT - Native

Present Incidence

1 - High Population
2 - Moderate Population
3 - Low Population
4 - Present, but insignificant

Potential for increased or Sustained High Populations

A - Highly likely
B - Moderately likely
C - Not likely

PEST/HOST	CATEGORY AND DAMAGE RATING	COMMENTS
HARDWOOD DISEASES		
Ash anthracnose green ash	URB-3A, SHL-3A, PRK-3A, NAT-4B	
Black knot chokecherry, Mayday	URB-2B, SHL-2B, PRK-2B, NAT-2C	
Cedar apple rust Hawthorn, Juneberry	URB-2A, SHL-2B, PRK-2B, NAT-3C	
Dutch elm disease American elm	URB-2A, SHL-3B, PRK-2A, NAT-1A	
Fireblight Apple, crab apple, cotoneaster	URB-2B, SHL-2B, PRK-2B, NAT-3C	
Poplar canker Hybrid poplars	URB-2B, SHL-2A, PRK-2A, NAT-3B	
Russian olive canker Russian olive	URB-2B, SHL-2B, PRK-2B	
Siberian elm canker Siberian elm	URB-2A, SHL-1A, PRK-2A	

PEST/HOST	CATEGORY AND DAMAGE RATING	COMMENTS
Valsa canker Prunus sp.	URB-3B, SHL-3B, PRK-3B	
Western X disease Chokecherry	URB-2B, SHL-2B, PRK-2B, NAT-1B	
Wetwood Elm, cottonwood, hybrid poplar	URB-1A, SHL-1B, PRK-1A, NAT-2B	
CONIFER DISEASES		
Cedar apple rust juniper, cedar	URB-2B, SHL-2B, PRK-2B, NAT-3C	
Cytospora canker Spruce	URB-2B, SHL-2B, PRK-2B	
Diplodia blight Ponderosa pine	URB-4B, SHL-4B, PRK-4B, NAT-4C	
Lirula needleblight	URB-4B, SHL-3B, PRK-4B	
Rhizophaera needle cast Blue spruce	URB-3B, SHL-2B, PRK-3B	
Western gall rust Ponderosa pine	URB-3B, SHL-3B, PRK-3B, NAT-3C	

DIAGNOSING TREE PROBLEMS USING INJURY SYMPTOMS

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INTRODUCTION

By comparing injury symptoms to examples listed in this guide, it is possible to identify over 140 specific insect, disease or abiotic tree and shrub problems. For the novice, this provides a "name" that can be used for further investigation by referring to a suitable text or in calls to pest specialists. For those more familiar with tree problems, this guide may serve as a check list or a reminder of less often encountered problems.

HOW TO USE THIS GUIDE

This guide is broken down by injury to conifers or deciduous trees and shrubs. Within each there are four major categories: **I. INJURY TO FOLIAGE, II. INJURY TO TWIGS OR NEW SHOOTS, III. INJURY TO TRUNKS OR LARGER BRANCHES and IV. ENTIRE TREE DYING.**

To identify a problem, determine the specific nature of the injuries and compare them with examples in the chart.

EXAMPLE: You notice that leaves are being eaten on your elm trees, and while examining the problem you disturb the foliage and caterpillars fall down and hang suspended on a silken thread.

TO IDENTIFY, GO TO:

I. INJURY TO FOLIAGE
A. Leaves being eaten
4. No webbing, but larvae hang from a thread when the foliage is disturbed (cankerworms and associates).

IDENTIFICATION; elms: spring cankerworms.

Although a large percentage of the commonly encountered problems are included, keep in mind there are many that could not be included and new ones continue to appear every year.

Please feel free to contact the North Dakota Forest Service if you have questions. And please remember, the first step in control or problem evaluation is proper identification.

CONIFERS

DIAGNOSING TREE PROBLEMS USING INJURY SYMPTOMS

I. INJURY TO NEEDLES

A. Needles being eaten

1. **Webbing present,** (bud cap often retained by silk)
   spruce: spruce budworm
2. **No webbing**
   pine: introduced pine sawfly, European pine sawfly
   spruce: yellow headed spruce sawfly, tussock moth
   larch: larch sawfly

B. Needles damaged or missing, but not consumed, may be off color or have discolored spots or bands or be mined out

1. **Spruce needles fade to purplish or brownish and fall off;** Rhizophaera needlecast, (current years needles undamaged)
2. **Pine needles fading to yellowish and developing brownish spots or bands, (second year or older needles);** Nemacyclus, (Cyclaneusma) needlecast
3. **Needles with small waxy white spots**
   pines and spruce: pine needle scale
4. **Needles being mined out in the needle sheaths**
   pines: tip moths, pine needle sheath miner
5. **Needles mined out, usually a tiny hole visable**
   spruce: spruce needle miner
   larch: larch casebearer
6. **Needles off color due to microscopic stippled areas, microscopic webbing may be present, individual mites very tiny, not usually visable to the naked eye except on a white background**
   spruce, junipers, arborvitae: spider mites,
7. **Needles with brown spots or dead ends**
   Pines: Lophodermium needlecast, winterburn, herbicide damage

II. INJURY TO TWIGS OR NEW SHOOTS

A. Shoots dying, deformed or stunted

1. **New shoots stunted or dying**
   pines: Diplodia tip blight
   Scotch & mugho pine: dieback symptom (cenangium) spruce: white pine weevil
   junipers: Kabitina tip blight
2. **Buds and new shoots dying, being mined out**
   pines: pine tip moth
3. **Buds being mined out, small pitch mass present**
   ponderosa pine: metallic pine pitch nodule maker

4. **Large aphids on twigs, branches or main stem**
   pines and spruce: giant conifer aphid
5. **Single gall consisting of large numbers of chambers, near the base of new shoots**
   spruce: eastern spruce gall adelgid
6. **Individual galls grouped together on stems**
   spruce: spruce gall midge

III. INJURY TO TRUNKS OR LARGER BRANCHES

A. Injury to branches

1. **Entire branches dying, lower branches first**
   spruce: Cytospora canker
2. **Woody galls on branches of pines, surface ruptures in the spring revealing an orange spore mass** ponderosa and scotch pine: western gall rust
   Irregular sized woody galls on junipers or cedars, may swell to large gelatinous mass in wet weather
   Junipers and cedars: cedar apple rust
   Large pitch masses in branch whorls or on the trunks of pines, may cause branch failure or stem breakage, pitch masses turn yellowish with age
   pines: Zimmerman pine moth complex
3. **Medium sized, similarily shaped pitch masses, or pitch tubes, on the lower bole of tree**
   pines: red turpentine beetle
4. **Regular sized, evenly spaced rows of holes in the bark of the main trunk or large branches**
   all species: sapsuckers (a woodpecker)
5. **Small regularily shaped tunnels under the bark, usually scoring both bark and wood, or a "shothole" pattern in the bark (bark beetles)**
   pines: pine engravers,(ips sp), spruces: spruce bark beetle
6. **Witches brooms, clusters of shoots all orginating near the same point**
   junipers: cedar apple rusts
   pines: Western gall rusts

IV. ENTIRE TREE DYING

A. Dying with needles on

pines: **Ips bark beetles, red turpentine beetle**
all species: chemical damage, herbicides or soil sterilents, girdling by small rodents, beavers, or porcupines, also by mechanical damage from, lawn mowers, string trimmers, weed barriers, ice, circling roots etc.
all species: drought damage, winter injury

HARDWOOD TREES & SHRUBS

DIAGNOSING TREE PROBLEMS BY USING INJURY SYMPTOMS

I. INJURY TO FOLIAGE

A. Leaves being eaten

1. **Webbing present, Larvae forage from silken nests**
   chokecherry; ugly nest tent caterpillar
   Prunus, apples prairie tent caterpillar
   many species; fall webworm
2. **Webbing present, no organized nest, but larvae rest on a silken mat placed on the trunk**
   Many species; forest tent caterpillar
3. **No webbing, but larvae hang from a thread when the foliage is disturbed** (cankerworms and associates)
   elms; spring cankerworms,
   green ash, boxelder, bur oak; fall cankerworm, many hardwood species; cankerworms, linden looper, elm spanworm and the half wing geometer may be found in any combination on a particular host
4. **No webbing, free feeding caterpillars**
   Many species of trees and shrubs; there are dozens of species that may be present, usually in low numbers that pose no problems for the host
5. **No webbing, free feeding, but not caterpillars**
   caragana; blister beetles, grasshoppers
   cottonwood, poplars; cottonwood leaf beetle
6. **Leaves folded or tied, with a larvae inside**
   green ash; fruit tree leaf roller
   oak; oak leaf roller,
   aspen; early aspen leaf roller, large aspen tortrix

B. Leaves not eaten, but missing or falling and have discolored spots or dead areas on them

poplars and Caragana; Septoria leaf spot disease
green ash; ash anthracnose

C. Leaves present but damaged

1. **Upper surface of leaf consumed**
   cotoneaster, prunus; pear slugs
   elms; elm leaf beetle
2. **Curled leaves with a woolly mass of aphids inside**
   American elm; wooly elm aphid, woolly apple aphid
3. **Aphids or aphid/like insects on underside of leaf**
   many species; aphids, especially on new growth
   American elm; European elm scale (June/July only)

4. **Yellowish stippled areas on upper surface, black deposits underneath, small black and yellow bug** green ash: ash plant bug
5. **Leaves bronzed or faded with black deposits on underside, insects very delicate in appearance**
elms, oak, Juneberry, cotoneaster,hawthorns; lace bugs, spider mites
6. **Bladder-like or warty growths on either surface of the leaf, (insect or mite galls)**
America elm: elm leaf gall
hackberry: hackberry nipplegall
boxelder: warty leafgall
honeylocust: honeylocust pod gall midge
many species: insect or mite galls
7. **Oak leaves with dense woolly pile-like growths, colors vary from white to reddish or yellowish**
bur oak: woolly oak gall wasp
8. **Dense feltlike patches on the surface or depressions filled with feltlike hairs, (erineum), color can vary from green to brick red**
boxelder, maples: erineum galls
9. **Distorted new growth, smaller than normal cupped leaves with wavy margins, abnormal color**
boxelder, Siberian elm: phenoxy herbicides
many species: herbicide damage
10. **Leaves mined between surfaces**
populus: leafmining sawfly
elms, elm leafminer
birch: birch leafminer
11. **Leaves with necrotic areas, sometimes joining to damage entire leaf**
green ash: ash anthracnose
oak: oak anthracnose
12. **Leaf spots, may be lighter colored in the center,**
populus: Septoria and Marssonia
caragana: Septoria
maples: Phyllosticta leaf spot
prunus: fungal and bacterial leaf spots
green ash: anthracnose
apples: frogeye leafspot (black rot), apple scab, cedar apple rust
13. **Leaf spots, black spots resembling tar,**
maples and willows: tar spot fungus
14. **Leaves with yellowish or whitish dusty deposits**
lilac and honeysuckle: powdery mildew
poplars and willows: Melampsora leaf rusts
15. **Leaf lesions, with hornlike structures, mainly on undersurface of leaf**
apples, hawthorn and Juneberry: cedar-apple rust
16. **Leaves develop early fall color, sparse foliage**
chokecherry: western x-disease
17. **Leaves yellowing between veins, veins remain green**
maples, and others: chlorosis, mineral deficiency
18. **Leaf margins scorched, all species,** especially lindens and maples
leaf scorch from hot winds, salt damage
19. **Leaf petioles with marble like galls on them**
cottonwood and poplars: poplar petiole gall aphids

20. **Frothy mass of spittle containing a small insect**
many species; spittlebugs

II. INJURY TO TWIGS OR NEW SHOOTS

A. Shoots dying, deformed or stunted

1. **Shoots and leaves dying or deformed**
many species; aphids, herbicide damage
2. **Witches' brooms**
honeysuckle; honeysuckle aphid
Juneberry; black leaf witches' broom
oak; oak anthracnose
3. **Shoots ending a with a brain shaped gall**
cottonwood; vagabond aphid gall
4. **Cauliflowerlike growth behind, or over buds**
poplars; poplar bud mite gall
5. **Black clusters hanging from twigs,** green ash; ash flower gall mite
6. **Large globular galls on twigs**
rose; rose twiggall
oak; oak bullet gall
7. **Twig terminating in a cone like structure**
willows; pine cone willow gall
8. **Swollen area on small twigs**
boxelder; boxelder twig borer
9. **Twigs dying, leaves blackened**
apples, cotoneaster; fire blight
Juneberry; black leaf witches broom

III. INJURY TO TRUNKS OR LARGER BRANCHES

A. Injury to branches

1. **Entire branch dying**
American elm; Dutch elm disease, native elm wilt
apples, mountain ash, cotoneaster; fireblight, black rot cankers
~~Hypoxalon canker~~
~~chokecherry; Western X-disease~~
~~green ash; Western ash bark beetle~~
poplars; **Septoria, Cytospora** or **Dothichiza** cankers
Russian olive, Siberian elm; **Botryodiplodia** or **tubercularia** canker
many species; various canker diseases
prunus; Valsa canker
2. **Branches or trunk with small immobile spot like structures that can easily be dislodged, may occur singly, in irregular patches or cover large areas, color varies with the species, (scale insects)**
poplars; scurfy scale(white), San Jose scale(grey)
American elm; European elm scale
many hardwoods; lecanium scale (large-dark-brown), oystershell scale (small, elongate, greyish-brown)
3. **Elongate thick blackish growths on branches**
chokecherry, prunus; black knot
4. **Holes in trunk, often associated with sawdust** green ash; ash borer, carpenterworm

poplars: poplar borer, bronze poplar borer
oak: two lined chestnut borer
birch: bronze birch borer
many hardwoods: poplar/willow borer, pigeon tremex

5. **Regular sized rows of holes in the bark of the main trunk or large branches**
many species: sapsuckers (a woodpecker)

6. **Small regular tunnels under the bark, or shothole pattern in the bark (bark beetles)**
American elm: native elm bark beetle, European elm bark beetle
green ash: Eastern ash bark beetle,
chokecherry, prunus: peach bark beetle, shothole borer (bark beetle)

7. **Trunks or crotches oozing foul smelling sap, may kill vegetation where it drips**
elms, poplars: bacterial wetwood (slime flux)

8. **Trunks with shelf like or hoof-shaped growths** green ash: Perennipora (Fomes), heart rot fungus
buffaloberry: Perennipora, heart rot fungus

9. **Burl-like or gall-like growths on trunks and larger branches**
cottonwood and poplars: Diplodia gall and rough bark of poplars (a fungus disease)

10. **Dead areas of bark extending vertically, usually on the south or west sides of main trunks**
mountain ash, maples, lindens, Malus and others: sunscald, mainly due to late winter low angle sun

11. **Uniform dieback of top branches**
all species: usually associated with root injury or death. Some common causes of root dieback are: oxygen starvation due to soil compaction or poor drainage, excessively dry soil, chemical damage, or mechanical injury, girdling roots (see below). Insects or diseases are only rarely responsible for significant root injury.

12. **Bark on branches and/or main trunk blackened**
American elm, and rarely other hardwoods
sooty mold fungus growing on "honeydew" produced by sapfeeding insects, most commonly wooly elm
aphids and European elm scale on American elm.

IV. ENTIRE TREE DYING

A. Dying with leaves on

American elm: Dutch elm disease
oaks: two lined chestnut borer
birch: bronze birch borer
chokecherry: Western X-disease (may not leaf out)
many species: girdling by: canker diseases, small rodents, beavers, or porcupines, mechanical damage from: lawn mowers, string trimmers, weed barriers
Trees may be girdled by their own roots, this may be indicated by a lack of root flare above the girdling portion of the roots of larger trees.

LIST OF COMMON AND SCIENTIFIC NAMES

PESTS	SCIENTIFIC NAME
Ash borer (lilac borer)	Podosesia syringae
Ash and privet borer	Tylonotus bimaculatus
Ash flower gall mite	Eriophyes fraxiniflora
Ash plant bug	Neoborus amoenus
Aspen leafminer	Phyllocnistis populiella
Blackheaded ash sawfly	Tethida cordigera
Blister beetles	Epicauta sp.
Ash gray blister beetle	Epicauta fabricii
Caragana blister beetle	Epicauta subglabra
Boxelder twig borer	Proteoteras willingana
Bronze poplar borer	Agrilus liragus
Bronze birch borer	Agrilus anxius
Caragana aphid	Acyrthosiphon caraganae
Caragana blister beetle	Epicauta subglabra
Carpenterworm	Prionoxystus robiniae
Cecropia moth	Hyalophora cecropia
Chokecherry aphid	Aphis cerasifolia
Cottonwood borer	Plectrodera scalator
Cottonwood leaf beetle	Chrysomela scripta
Eastern ash bark beetle	Hylesinus aculeatus
Eastern spruce gall adelgid	
Early aspen leaf roller	Pseudexentra oregonana
Elm lacebug	Corythucha ulmi
Elm leaf beetle	Pyrrhalta luteola
Elm leafminer	Fenusa ulmi
Elm sawfly	Cimbex americana
European elm bark beetle	Scolytus multistiatus
European elm scale	Gossyparia spuria
European fruit lecanium	Lecanium corni
European pine sawfly	Neodiprion sertifer
Fall cankerworm	Alsophila pometaria
Fall webworm	Hyphantria cunea
Forest tent caterpillar	Malacosoma disstria
Fruittree leafroller	Archips argyrospilus
Giant conifer aphid	Cinara species
Grasshoppers	Melanoplus species
Great ash sphinx	Sphinx chersis
Hackberry nipplegall maker	Pachypsylla celtidismamma
Honeylocust pod gall midge	Dasineura gleditchiae
Honeysuckle witches broom aphid	Hyadaphis tataricae
Introduced pine sawfly	Diprion similis
Lace bugs	Corythucha species
Larch casebearer	Coleophora laricella
Larch sawfly	Pristiphora erichsonii
Leaf crumpler	Arobasis indigenella
Lecanium scale	Lecanium corni
Linden looper	Erannis tiliaria

Metallic pine pitch nodule maker	Retinia metallica
Mourningcloak butterfly	Nymphalis antiopa
Native elm bark beetle	Hylurgopinus rufipes
Oak bullet gall	Disholcaspis quercusmamma
Oak lace bug	Corythucha arcuata
Oystershell scale	Lepidosaphes ulmi
Peach bark beetle	Phloetribus liminaris
Peach tree borer	Synanthedon pictipes
Pear slug	Caliroa cerasi
Pigeon tremex	Tremex columba
Pine cone willow gall	Rhabdophagus strobiloides
Pine engraver bark beetles	Ips sp. (calligraphus & pini)
Pine needle scale	Chionaspis pinifoliae
Pine needle sheathminer	Zelleria Heimbachi
Pine tip moths	Rhyacionia species
Poplar and willow borer	Crypthorhnchus lapathi
Poplar borer	Saperda calcarata
Poplar bud gall mite	Aceria parapopuli
Poplar petiole gall aphid	Pemphigus populitransversus
Poplar vagabond aphid	Mordwilkoja vagabunda
Prairie tent caterpillar	Malacosoma californicum lutescens
Red humped oakworm	Symmerista albifrons
Red turpentine beetle	Dendroctonus valens
Rose twiggall	Diplolepsis spinosa
San Jose scale	Quadraspidiotus perniciosus
Scurfy scale	Chionaspis species
Shothole borer	Scolytus rugulosus
Smaller European elm bark beetle	Scolytus multistriatus
Spider mites	Oligonychus species, Tetranychus species & Eotetranychus species
Spring cankerworm	Paleacrita vernata
Spruce budworm	Choristoneura fumiferana
Spruce needleminer	Endothenia albolineana
Spruce gall midge	Mayetiola piceae
Spruce spider mite	Oligonychus unuguis
Tip borer, Scotch pine	Dioryctria species
Tip moths	Rhyacionia species
Two lined chestnut borer	Agrilus bilineatus
Tussock moth	Parorgyia grisefacta
Uglynest caterpillar	Archips cerasivorana
Variable oakleaf caterpillar	Heterocampa manteo
Warty leafgall	Aceria negundi
Western ash bark beetle	Hylesinus californicus
Western pine tip moth	Rhyacionia bushnelli
White-banded ash bark beetle	Hylesinus fasciatus
White-spotted pine sawyers	Monochamus scutellatus
Woolly elm aphid	Eriosoma americanum
Yellow-headed spruce sawfly	Pikonema alaskensis
Zimmerman pine moth complex	Dioryctria ponderosae, Dioryctria tumicolella Dioryctria zimmermani

DISEASES	SCIENTIFIC NAMES
Anthracnose (ash)	Gloeosporium aridum
Anthracnose (oak)	Gnomonia quuercina
Black knot	Apiosporina morbosa
Black rot (frogeye leafspot)	Physalopora obtusa
Cedar apple rust	Gymnosporangium sp.
Cytospora canker (spruce	Cytospora kunzei
Diplodia tip blight (pines)	Diplodia pinea
Dutch elm disease	Ceratocystis ulmi
Fireblight	Erwinia amylovora
Frogeye leafspot (blackrot)	Physalopra obtusa
Kabatina tip blight	Kabatina juniperi
Nemacyclus (Cyclaneusma) needlecast	Naemacyclus minor
Poplar cankers	Cytospora sp.
	Phomopsis sp.
	Dothichiza populea
	Septoria musiva
Rhizosphaera needlecast	Rhizosphaera kalkhoffii
Russian olive cankers	Botryodiplodia theobromae
	Tubercularia ulmea
	Phomopsis arnoldiae
Siberian elm canker	Botryodiplodia hypodermia
	Tubercularia ulmea
Sooty mold	Unknown sp.
Valsa canker	Valsa sp.
Western gall rust	Endocronartium harknessii
Western X disease	A Mycoplasma like organism (MLO)
Wetwood	Enterobacter cloacae

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